1,066,029

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,066,029

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COMPLETE SPECIFICATION

An improved Gimbal Arrangement

We, HAYNES AND HAYNES LIMITED, a British Company, of 82 King William Street, London, E.C.4, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a gimbal arrangement which can be used with elongated articles of preferably, but not essentially, tubular form which are arranged to pass through the arrangement.

The gimbal arrangement is particularly, but not exclusively, designed for use with a monitoring or measuring head for detecting and regulating the thickness and dimensions of a tube or rod which is being produced by an extrusion machine. The tube or rod is most probably of a thermo-plastic material and due to the fact that it has only shortly left the extrusion machine before entering the gimbal arrangement it is necessary that a monitoring or measuring device carried by the said arrangement should not bear on the tube or rod too heavily in case deformation is caused by those parts of the head touching the tube or rod passing through it. In the specifications of Patents Nos. 880,184, 880,185 and 881,071 there is described a monitoring head for measuring the wall thickness of plastic tubing and the gimbal arrangement of the invention is designed particularly to carry a head of a type similar but improved to that described in these prior patents.

It is an object of the present invention to provide a gimbal arrangement including a head member which bears constantly on an elongated member arranged to pass through it and which stays in contact with the elongated member in spite of minor variations in the dimensions of that member, or minor changes in its position or angle.

According to the present invention a gimbal arrangement comprises a first frame member arranged to pivot about a first pivotal axis and a second frame member arranged to pivot about a second pivotal axis, transverse to said first pivotal axis, said pivotal axes intersecting at a point of balance of the second frame member, said second frame member carrying on one side of the point of balance a counterbalance weight and on the other side of the point of balance a head member, said head member being pivotally supported from a stirrup and the pivotal support having a pivotal axis comprising a third pivotal axis parallel to said first pivotal axis, said stirrup being pivotally secured to the second frame member and arranged to pivot about a fourth pivotal axis located in a plane parallel to said second pivotal axis; the said second and fourth pivotal axes and the centre of gravity of the counterbalance weight being arranged to lie substantially in a common plane.

Bias means may be provided to urge the head member in a preferred direction and said bias means may comprise tensioned springs.

The head member is preferably supplied with a plurality of bearing faces arranged to engage with a tube or similar elongated member on which the head bears, two of these bearing faces being symmetrically distributed in a common plane including the fourth pivotal axis. The bearing faces should preferably be equally distributed relative to the pivotal axis of the stirrup to counteract any turning movement of the head member and may be on a line including the third pivotal axis, the said line being parallel to the direction of progression of a tube or other elongated member through the arrangement. A second two bearing faces may be provided symmetrically distributed about the third pivotal axis and being adjustable in position to bear tangentially on a tube or elongated member along a line parallel to the direction of progression of a tube or other elongated member passing through the arrangement. The bearing faces may be of nylon or, preferably, they may comprise of a ball race. The gimbal arrangement may be either

[*Price 4s. 6d.*]

of a stationary character or it may be arranged to be rotated about the elongated member.

The pivotal points forming the fourth pivotal axis may be adjustable in their connection with the stirrup so that the support, and thus the head carried thereby, can be moved to accommodate various sizes of tube or other elongated members which may be passed through the arrangement.

In order that the invention may be readily understood one construction of a gimbal arrangement in accordance therewith will now be described by way of example only with reference to the three Figures of the accompanying drawings which respectively in Figures 1, 2 and 3 are side, end and top plan views.

The arrangement shown includes a measuring head for continuously measuring by capacitive means the wall thickness of a thermoplastic pipe as it emerges from an extruding machine. The head itself does not form part of the invention but may be, for example, of the kind shown in the specification of Patent No. 881,071.

Referring now to the drawings, the arrangement comprises a base member 1 to which is secured a vertical rectangular support structure 2 having inclined bracing members 3. The support structure 2 is of a general plate shape and has a central aperture 4 through which a tube 5 can easily pass. Projecting from the structure 2 are two bearing lugs 6, 7 arranged on the vertical centre line of the aperture 4 as shown.

A first frame 8 comprising four members arranged in a square configuration and supported by braces 9 at their corners, is mounted on two vertically arranged pivots 10, 11 engaging with the lugs 6, 7 respectively connected to a support member 2. These pivots form a first pivotal axis A for the arrangement and allow the first frame member 8 to pivot about them to a degree which is only limited by the distance of the support member 2 from the frame, the support member thus forming a stop for two extreme positions of the frame. At its top end the first frame 8 carries on two extension arms 14, 15, a second frame 16 of a generally rectangular nature. This second frame 16 is pivoted approximately midway along its length at points 17, 18 in the extensions 14, 15 of the first frame 8 and the pivotal mounting of the second frame forms a second pivotal axis B about which the second frame pivots.

The second frame 16 carries at one end a counterblance weight 19 which is adjustable in two ways. Firstly its distance between the second pivotal axis B and the end of the frame can be altered and secondly its weight can be varied by adding or subtracting weights thereon. At the other end of the second frame member 16 a stirrup 20 is provided which is pivotally secured by pivots 21, 22 at its ends to the ends of the second frame member. The stirrup 20 carries at its centre a pivotal point 23 to which a head member 24 is connected. This head member is thus able to rotate about a vertical pivotal axis forming a third pivotal axis C which is parallel to the first pivotal axis A. The stirrup 20 can rotate about a fourth pivotal axis D formed by the points 21, 22 which is horizontally arranged. The ends of the stirrup 20 and its connection to the pivotal point at the end of the second frame member 16 are made adjustable.

The head member 24 in this example of construction comprises a substantially semi-cylindrical hood which carries capacitor plates for monitoring the wall thickness of the extruded tube 5 of plastics material. The hood carries four bearing faces two of which are fixed and two of which are adjustable. The two fixed faces 25, 26 are of nylon and are attached to the hood in a position such that the bearing faces make contact with the exterior of the tube in a first plane which includes the fourth pivotal axis D which supports the stirrup 20 and in a second plane which includes the third pivotal axis C about which the head member 7 can rotate relative to the stirrup 20. The other two bearing faces of which only one is visible — Figure 2, each comprises a ball race bearing 27 carried on the end of an arm 28 which is adjustably mounted on a calibrated rod 29 set at 45° to the horizontal. These rods 29 are mounted at opposite ends of the hood and on the same side of the tube 5. In operation it is arranged that the fixed bearing faces 25, 26 will engage on the uppermost portion of the tube and the ball race bearing 27 will engage on the side of the tube at the point furthest from the vertical arm through the centre of the tube, thus the two sets of bearing faces 25, 26 and 27 are set relative in places which are 90° displaced on each other. It is essential that the friction between the tubes and the bearing faces be kept as low as possible to prevent the bearing faces digging into the tube and marking it and to prevent the head from being thrown out of engagement of the tube as it passes through the heads. Returning to the head member 24 and stirrup 20 the combined centre of gravity of these two components is arranged to lie on the fourth pivotal axis D. The point representing this combined centre of gravity, the fourth pivotal axis D, the second pivotal axis B, and the point constituting the centre of gravity of the counterbalance weight 19, thus all are arranged to lie in one plane. The counterbalance weight 19 is adjusted so that it exactly balances the head member 24 and stirrup member 20 so that there is no turning moment of the second frame 16 about the second pivotal axis B and the point of balance and centre of gravity of this frame occur at this axis, so that if the head is placed on the tube it rests there with no weight bearing on the tube at all. This is the ideal condition

for the head and it will be appreciated that due to the frictional force that occurs at the faces when the tube is passed through the arrangement that a turning moment will occur which will tend to throw the head out of engagement with the tube. To overcome this it is necessary to bias the head member 24 slightly towards the tube 5 and this is done by connecting bias springs 31, 32 between the head side of the second frame 16 and the first frame 8 so that the head is brought into contact with the tube by virtue of the action of the springs 31, 32. The strength of the springs is selected so that the desired pressure of the head member on the tube is achieved, and fixing posts 33, 34 on the second frame 16 is so positioned relative to the pivots 14, 15 and the rating of the spring is so calculated that the vertical pressure of the head on the tube is substantially constant over required range of head positions. A corresponding biassing spring 35 is connected between a post 36 on the support structure 2 and an arm 37 on the first frame 8 to give the frame a slight bias so that the bearings 27 on each end of the head, have the same contact pressure on the tube 5 as bearings 25 and 26.

When the arrangement is fitted with a capacitive monitoring head then it is set up near to the machine (not shown) extruding the tubing to be monitored so that the tube on leaving the extrusion machine passes through the arrangement. The head can be arranged to bear on the tubing with a pressure of a few ounces although the head itself can weigh many pounds and if the tubing on leaving the extrusion machine wanders slightly then the head can follow the tubing while still keeping in contact with its without leaving the tubing to follow a practically straight path. Any wandering of the tubing can be resolved into horizontal and vertical components and the horizontal components can be accommodated by movement of the first frame 8 about the first pivotal axis A and by movement of the head member 24 about the third pivotal axis C of the stirrup 23 from which it is suspended; the vertical component can be accommodated by movement of the head member 24 about the fourth pivotal axis D and by movement of the second frame 16 about the second pivotal axis B. If a fault occurs in the extrusion machine and the tube 5 becomes oversize the head member 24 is simply pushed away from the tube and is not damaged thereby. It will be appreciated that by its nature the arrangement requires no elaborate setting up and is easy and simple to use. It is also simple to adjust the position of the bearing faces by movement of the clamp 28 to allow for different sizes of tubing which may be passed through the head.

The description has so far been limited to a stationary head but it will be appreciated that the gimbal arrangement described can be mounted on a rotating member so that it rotates constantly about the tubing. This can be especially useful when all round scanning (or sensing) of tube wall thickness is necessary, or when the head carries an electrical transducer for gauging the outer diameter of the tubing being manufactured since it will be able to pick up any local variations in the thickness or diameter, as the case might be, of the tubing over a relatively narrow sampling range. Due to the biassing arrangement the head member 24 will be kept in contact with the tube even when turned through 180° from the position shown.

The arrangement could equally be used with types of measuring apparatus using other existing techniques such as photo-electric detectors, air gauges and other transducers for diameter and ovality detection, ultrasonics for porosity, voids and thickness measurement and nucleonics for density or thickness measurement. All these methods of measurement would be improved, by the ability of the sensing head of whatever type to move automatically to the correct position for accurate measurement of tube, rod or profile, by the simple safety devices and by the light loading on the extrudate.

WHAT WE CLAIM IS:—

1. A gimbal arrangement comprising a first frame member arranged to pivot about a first pivotal axis and a second frame member arranged to pivot about a second pivotal axis transverse to said first pivotal axis, said pivotal axes intersecting at a point of balance of the second frame member, said second frame member carrying on one side of the point of balance a counterbalance weight and on the other side a head member, said head member being pivotally supported from a stirrup and the pivotal support having a pivotal axis comprising a third pivotal axis parallel to said first pivotal axis, said stirrup being pivotally secured to the second frame member and arranged to pivot about a fourth pivotal axis located in a plane parallel to said second pivotal axis; the second and fourth pivotal axes and the centre of gravity of the counterbalance weight being arranged to lie substantially in a common plane.

2. An arrangement as claimed in Claim 1, wherein bias means are provided to urge the head member in a preferred direction.

3. An arrangement as claimed in Claim 1 or Claim 2, wherein the counterbalance weight is adjustable.

4. An arrangement as claimed in any preceding claim, wherein the first and the second frameworks are of a symmetrical shape.

5. An arrangement as claimed in any preceding claim, wherein the head member is provided with a plurality of bearing faces arranged to engage with a tube or similar elongated member on which the head bears, the bearing faces being symmetrically distributed

in a common plane including the fourth pivotal axis.

6. An arrangement as claimed in Claim 5, wherein the bearing faces are equally distributed relative to the pivotal axis of the stirrup to counteract any turning movement of the head.

7. An arrangement as claimed in Claim 5 or Claim 6 wherein the bearing faces lie on a line including the said third pivotal axis, the said line being parallel to the direction of progression of a tube or other elongated member through the arrangement.

8. An arrangement as claimed in any one of Claims 5 to 7, wherein further bearing faces are provided on the head arranged perpendicular to the said bearing faces.

9. An arrangement as claimed in Claim 8, wherein the said further bearing faces are adjustably mounted on the head.

10. An arrangement as claimed in any preceding claim, wherein the second frame is adjustably connected to the stirrup at the fourth pivotal axis.

11. An arrangement as claimed in any preceding claim, and including rotatable mounting means so that the whole arrangement can be rotated about a central axis.

12. A gimbal arrangement substantially as hereinbefore described and illustrated with reference to the three Figures of the accompanying drawings.

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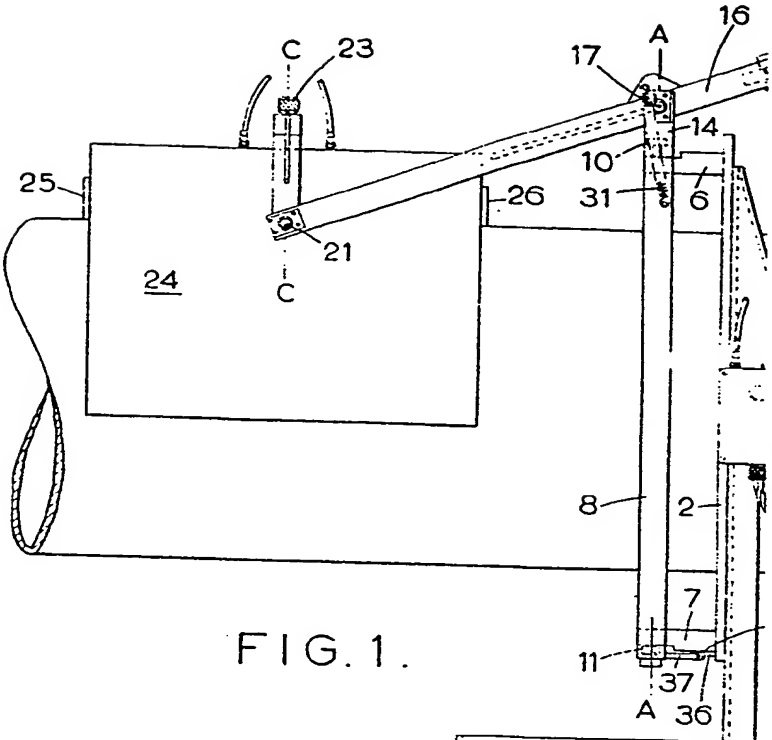
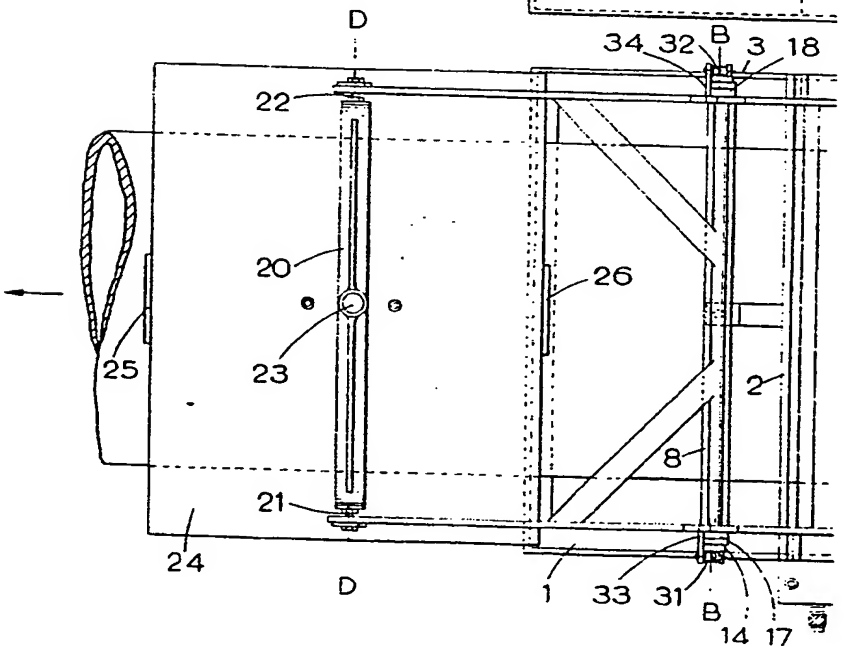
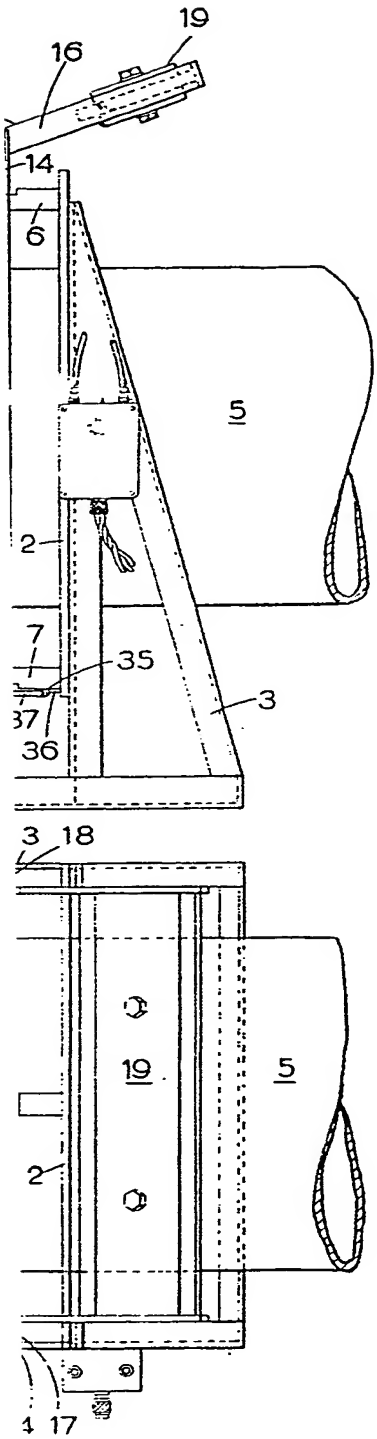


FIG. 1.

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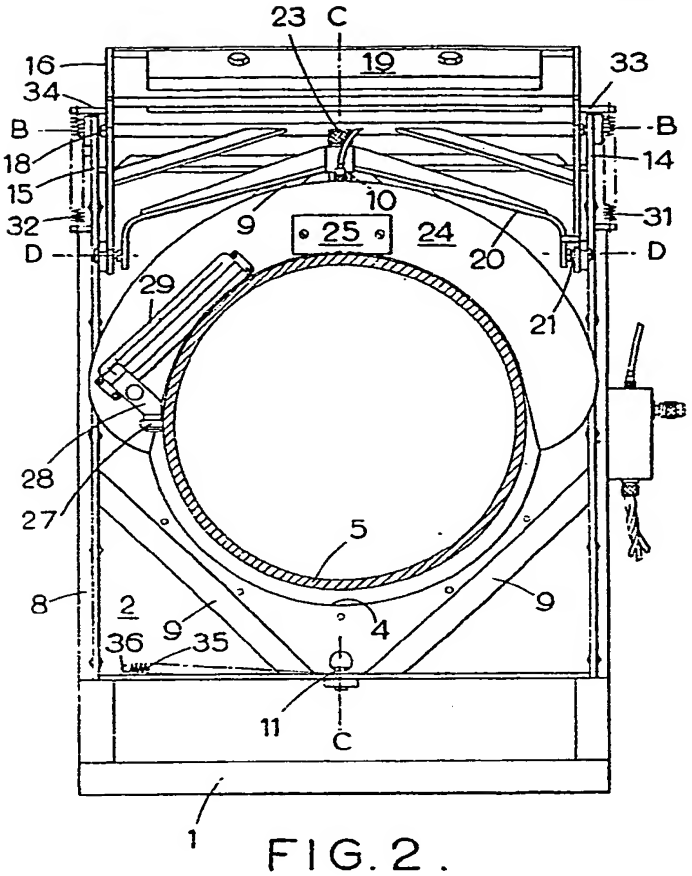
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FIG. 2.

FIG. 3.

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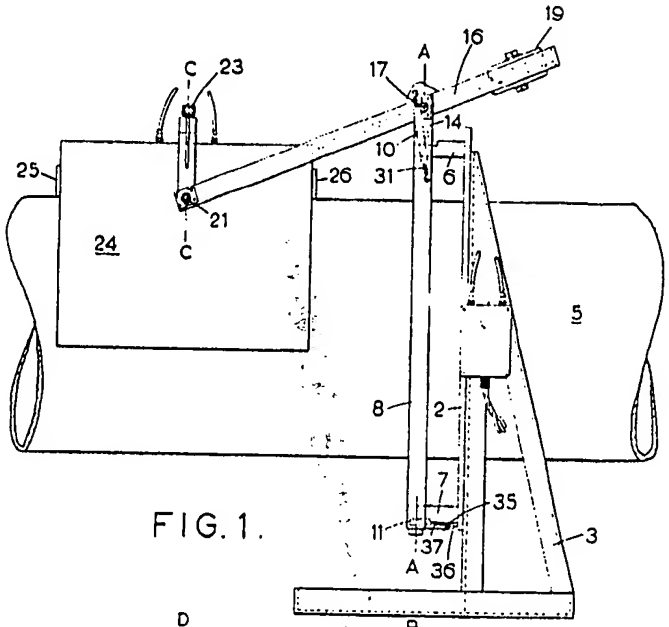

FIG. 1.

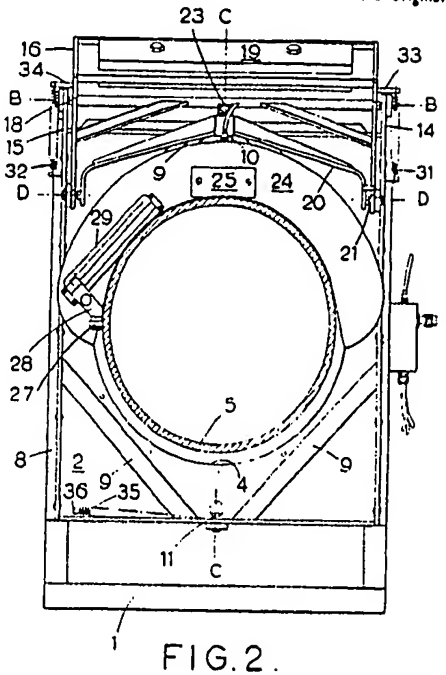

FIG. 2.

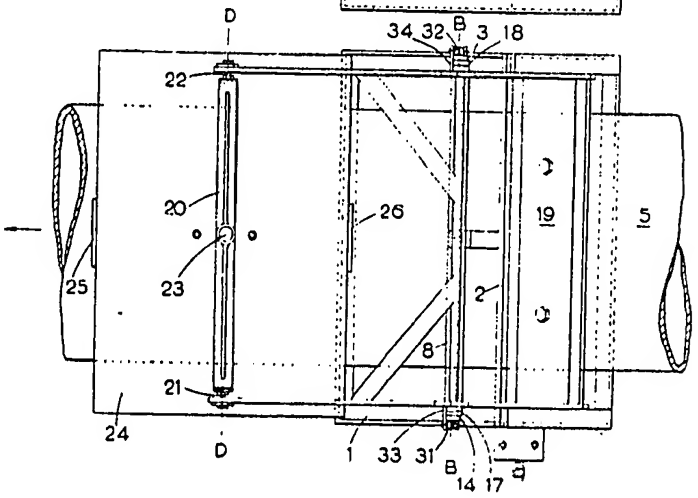

FIG. 3.